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CONSISTENCY METHODS AND STRUCTURES GEOMETRY OF DESIGNS APPLIED ON THE INTERNAL WALLS OF KIRMAN BAZAARS

Abstract. In this article the author clarifies the exploited markets in ancient cities such as Tabriz, Shiraz, Kirman, and geometrical and mathematical calculations of the geometrical structure of the arches, domes and their decorative compositions noting that the covered markets are still exploited.

In the national architecture of Iran the cover of large “dahanas” (corks) was made by the geometric shapes like brick, raw brick, arch built natural stone, and dome. As it is known, there is fewer wooden building materials in the country and in most regions of Iran, flat ceilings with pole and column have not been used or used less. Thus, Sardarabad in Kirman is taken as an example, and the sequence method and geometry of the projects implemented in its structure are studied. Application of geometry caused to remain Sardarabazar for centuries as an historical monument interpreted on the basis of mathematical calculations. Balancing and proportion of its structure elements, their characteristics of the ratio are analyzed. At the end of the article is shown that, the correct application of geometry from ancient times to the national architecture of Iran is considered to be the main factor for centuries of ancient buildings.

Key words: Kirman market, arc, decorative compositions, covered market, rectangular.

Introduction. The traditional, national covered bazaars of Iran, also Tabriz, Shiraz and Kirman bazars are still in use and keep their working capacity. Designs applied in these bazars consist of brick material, mostly, tag (arches), gunbez (dome) and “karbāndi”s. With their decorative compositions and beauty, these bazars are considered precious buildings. Cover of great “dāhanə” (corks) in the traditional national architecture of Iran were con-

structed from brick, raw brick, and natural stone materials and formed as arch, dome and “karbāndi”. Also, because of lack of wooden construction materials in Iran plane ceilings that constructed by shanks and columns were not or less used in most regions [1]. Especially, in Iran and dry climatic regions (Kirman, Kashan and others) cover of ceilings were like arch and dome form. Therefore, cover of the traditional national covered bazars were in arch, dome and “karbandi” shape. “Karbandis” made the condition of the building more useful and played internal decoration role of the building.

The interpretation of the main material. Besides “Karbandis” applied in these bazars, domes (small domes) in the upper parts of “Karbandis” were worked among the “dāhanəs” of colourful beauty designs in such a way that designs in each “dāhanəs” of bazars are very different from each other.

Sardar bazar of Kirman consists of several small bazars, crossing “rastə” (trading row) as a sample. Three main rastə joins freely to bazar. Sardarcara-vansary is fomed among three main rastə. This bazar locates in the centre of the ancient “baft” (structural junction) of Kirman. Consistency, methods and geometry of the applied designs are researched in the present article [4].

Picture 1. Kirman Sardar bazar corridor.

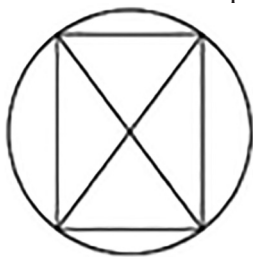
Picture 2. Arches, domes, small arches of Kirman Sardar bazar [5].

Karbāndi” designs that sued among the arches in the designs of Kirman bazar building is a simple decahedra, zamina of karbandi is foursquare. Sides are proportional and approximately are $b=4$, $a=3$, sides of karbandi are calculated as $2[(a+b)-2]$. $2[(3+4)-2]=10$.

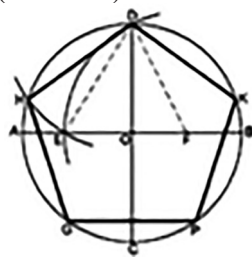
The medium (area) of circle is drawn on the quadrangular zamina (base). (Sketch 1). Then, one pentagonal is drawn as belowmentioned within the circle in order to divide the medium – area of circle into ten equal parts. AB and CD diameter of circle is drawn and BO radius is divided into two equal parts. Thus, F point is got. Then such Kaman



with FD radius the centre being F is drawn, so that it could cross AB line on the E point. Afterwards, the second Kaman with DE radius is drawn in the centre D and Kaman crosses AD arch on the H point. H and D points are connected. Thus, one side of pentagonal is obtained, other sides are also obtained with this method. The circle has been divided into five equal parts as a result (Sketch 2).



Sketch 1

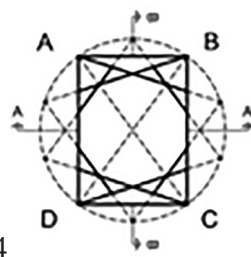


Sketch 2

HD, HG, GP and KD arches are divided into two equal parts according to the Sketch 3.



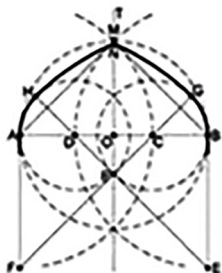
Sketch 3



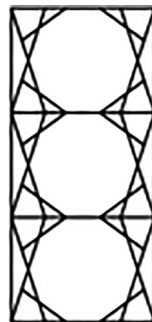
Sketch 4

An arc with radius more than $HD/2$ is drawn having H centre point on the HD point. So, radius is drawn being bigger than $HD/2$ in the D centre, perpendicular line is drawn from crossing of these two Kamanstowards HD Kaman and this perpendicular line divides HD Kaman into two equal parts. DK, PP, PG, GH arcs into two equal parts according to the said method. Thus encircled circle in the foursquare is divided into ten equal parts in the ABCD “zəminə” according to Sketch 3. As BC side of foursquare covers $1/3$ of circle, connects the points of circle in the form of 3×3 and lines of “karbəndi”’s plan are obtained from crossing to these lines according to sketch 4. At that time one arch can be considered for all lines of karbandi [3].

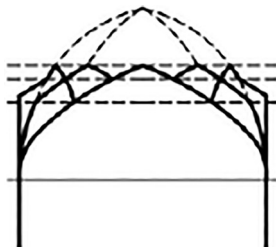
Here the arch(five and seven) may be considered as an arch according to the sketch 5. Three parameters “karbandi” of bazar “rastə” (coridor) is got from crossing of these arches according to the sketch 9.



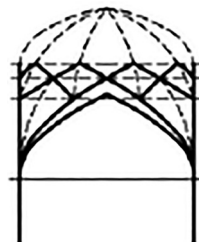
Sketch 5



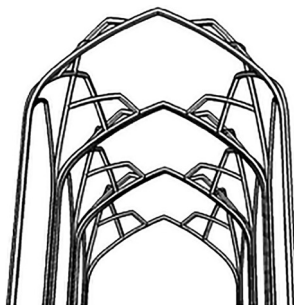
Sketch 6



Sketch 7 (B-B cut)



Sketch 8 (A-A cut)



Sketch 9. Geometry of three parameters “karbandi” of bazar Structure and geometry of decoration design of “Karbāndi” upper domes.

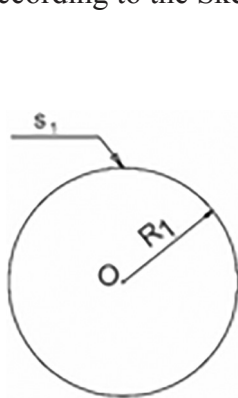
Picture 2. Geometric design of “Karbāndi” upper domes

Geometry of this design based on circle crossing and R1 radius is drawn equal to “şəmsə” radius according to S1 circle (sketch 10) in the first step while geometric drawing [6]. Then

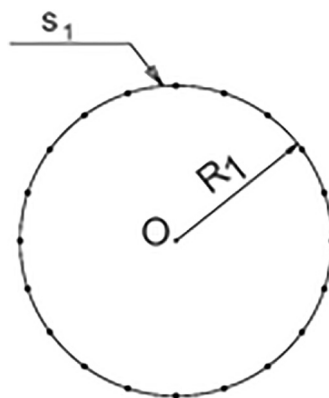


medium (area) of S_1 circle is divided into 20 equal parts (sketch 11). In the second step, they are connected to each other as one section of AB line in the form of 6x6 according to the Sketch 12. Another circle with $AB=R_2$ radius is drawn by considering each division of S_1 circle as a centre and it is called S_2 . For example, two points, a and b are considered as a centre.

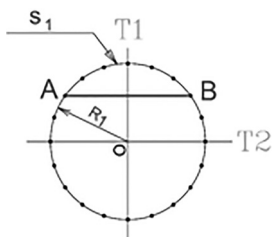
One circle with $AB=R_2$ radius is drawn in the A centre. Also, another circle with $AB=R_2$ is drawn in the B centre. K point is obtained from crossing of two circles on the T1 vertical line (diameter of circle). Then, the distance from 0 up to k is called R_3 . A circle with R_3 radius is drawn in O centre and is called S_3 (Sketch 13). External part of geometric pattern is obtained from crossing of S_2 circles [2]. Thus, geometric patterns are formed from crossing of S_2 circles according to the Sketch 14.



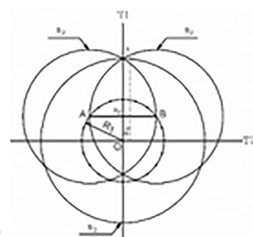
Sketch 10



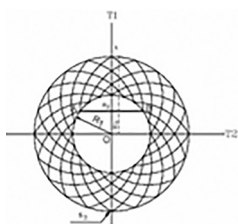
Sketch 11



Sketch 12



Sketch 13



Sketch 14

Conclusion. Operation and protection of historical national and traditional buildings, as well as, safeguarding of Sardar bazar in Kirman city as a historical monument was possible thanks to geometry science, because science of geometry allows defence and protection of traditional, national buildings, also plays great role in their being fascinating and proportional. So, balancing, proportionality and correlation of structural elements of a building is possible by means of geometric logic. Geometry played great role from the most ancient times in city architecture and town-planning in the world culture and was almost, one of the main factors of protection of these traditional – national buildings for many centuries.

References

- (1) بزرگمهری، زهره، هندسه در معماری، انتشارات سبحان نور 1385
- (2) توسلی، محمود، هنر هندسه، انتشارات پیام 1383
- (3) بوزجانی، ابوالوفاء، هندسه ایرانی (کاربرد هندسه در عمل)، انتشارات سروش 1384
- (4) شعرفاف، اصغر، گره و کاربردی، انتشارات سازمان ملی حفاظت آثار باستانی ایران 1361
- (5) رئیس زاده، مهناز و مفید، حسین، احیای هنرهای از یاد رفته، انتشارات مولی 1374
- (6) جمشید کاشانی، غیاث الدین، طاق و ازج، انتشارات سروش 1366

Əhməd Pənəhi (İran)

Kirman bazarının daxili divarlarının səthlərində tətbiq olunan layihələrin ardıcılıq üsulları və strukturlarının həndəsəsi

Hazırkı məqalədə müəllif Təbriz, Şiraz, Kirman kimi qədim tarixə malik olan şəhərlərdə örtülü bazarlarının hələ də istismar olunduğunu qeyd edərək bu bazarlarda tətbiq olunan layihələrin, tağların (arkaların), günbəzlərin həndəsi quruluşunu və onlara vurulan bəzək kompozisiyalarını həndəsi və riyazi hesablamalarla açıqlayır.

İranın milli memarlığında böyük “dəhanə”lərin (ağızlıqların) örtüyü kərpic, çiy kərpic, təbii daş materialından tikilmiş tağ, günbəz, kimi həndəsi formalar vasitə ilə aparılmışdır. Məlum olduğu kimi ölkədə taxta tikinti materialları az olduğundan İranın əksər regionlarında milləyə sütunla tikilən müstəvi tavanlardan istifadə olunmamışdır və ya az istifadə olunmuşdur. Odurki, Kirman şəhərindəki Sərdarbazarı bir nümunə kimi götürülərək onun “ (struktur quruluşunda tətbiq olunmuş layihələrin ardıcılıq üsulu və həndəsəsi araşdırılır, Sərdarbazarının əslər boyu tarixi abidə kimi qalmasına səbəb olan həndəsi elmin tətbiqi riyazi hesablamalar əsasında şərh olunur və onun struktur quruluş elementlərinin balanslaşdırılması və mütənasibliyi, nisbətləri xüsusiyyətləri təhlil olunur. Məqalənin sonunda göstərilir ki, həndəsə elminin lap qədim zamanlardan İranın milli memarlığında düzgün tətbiq olunması qədim binaların əslər boyu qalmasının əsas amilləri hesab olunur.

Açar sözlər: Kirman bazarı, tağ, dekorativ kompozisiyalar, örtülü bazar, dördbucaqlı.

Ахмед Панахи (Иран)

Методы последовательности и геометрия структур проектов, применённых на поверхности внутренних стен рынка Кирман

В статье автор, отмечая функционирование и в современности крытых рынков в таких городах, обладающих древней историей, как Тебриз, Шираз, Кирман, разъясняет с помощью геометрических и математических расчетов геометрическую структуру проектов, арок, куполов и используемых в них орнаментальных композиций, имеющих место в устройстве рынков.

В иранской национальной архитектуре сооружение базы было выполнено посредством таких геометрических форм, как арка, купол, при этом использовались кирпич, кирпич-сырец, природный каменный материал. Как известно, в связи с недостаточностью строительных материалов из дерева в стране, в большинстве регионов Ирана либо не использовались плоские потолки из шпилей и колон, либо к их возведению прибегали в очень редких случаях. Так, взятый в качестве образца рынок Сардар в городе Кирман, обуславливает изучение метода последовательности и геометрию проектов, примененных в устройстве его структуры, на основе математических расчетов объясняется применение геометрической науки как причина сохранности на протяжении веков рынка Сардар в

качестве исторического памятника, анализируется согласование и уравнивание его структурных элементов, соотношение особенностей. В заключение статьи показано, что верное применение с древних времен геометрии как науки в иранской национальной архитектуре считается основным фактором сохранности древних сооружений на протяжении веков.

Ключевые слова: Базар Кирмана, арка, декоративные композиции, крытый базар, четырехугольник.